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THESIS

**NONPROLIFERATION VS.
INDUSTRIAL COMPETITIVENESS:
U.S. EXPORT CONTROLS AND THE
DUAL-USE MACHINE TOOL INDUSTRY**

by

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June, 1995

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This thesis examines the tradeoff between nonproliferation objectives and commercial interests regarding controls on American exports of dual-use technologies. It also examines the tension between both unilateral and multilateral export controls for dual-use machine tools. Strong unilateral export controls reduce the competitiveness of the U.S. machine tool industry, while relaxation of controls threatens to increase the spread of weapons of mass destruction by making enabling technologies available to developing states. Given the increasing globalization of defense production, multilateral export controls offer the best opportunity to retard the spread of sensitive technologies, especially if these controls are led by a strong state that is prepared to guide their implementation, verification, and enforcement. In order to influence the behavior of target countries and to demonstrate American resolve for the principles of nonproliferation, controls should include both sanctions and positive incentives. The United States should lead multilateral export control regimes. If controls are properly applied, opportunities for commercial exports may expand in the long term. The case of Iraq provides important insights into the potential for nuclear and dual-use technology proliferation in the absence of well-enforced controls. The study uses the insights to argue for stronger controls, data-sharing, and monitoring to slow the spread of sensitive dual-use technology to other rogue states in the Middle East, particularly Iran.

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NONPROLIFERATION VS. INDUSTRIAL COMPETITIVENESS: U.S. EXPORT CONTROLS AND THE DUAL-USE MACHINE TOOL INDUSTRY

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EXECUTIVE SUMMARY

The threat to U.S. interests of the proliferation of weapons of mass destruction (WMD) has increased during the post-Cold War era primarily due to the globalization of defense technology industries. Diffusion of sensitive dual-use technologies, including precision machine tools, enables more countries to produce WMD components and the means for their delivery. Some dual-use technologies which were subject to controls during the Cold War are now too widely available for U.S. controls to prevent their emergence in new WMD programs. U.S. producers increasingly compete with foreign suppliers of advanced dual-use items. In order to provide the U.S. military with the most secure supply of advanced systems, these companies must remain competitive globally. More than ever, national security policy makers must balance military threats to the United States against the nation's economic security. Reform of U.S. unilateral export controls and the establishment of a regime to succeed the Coordinating Committee for Multilateral Export Controls (COCOM) are necessary steps. But unilateral and multilateral controls must complement each other to be effective in slowing the spread of WMD programs.

This thesis examines the tradeoff between industrial competitiveness and non-proliferation objectives. It develops a perspective toward export controls which balances the concerns of exporters against those of proponents of stronger nonproliferation policies.

While the economy is becoming more global, the political orientation in the United States is turning inward. Calls to retreat from international engagements in order to pursue American national interests threaten the viability of any COCOM successor. This

study argues that strengthening multilateral export controls serves American interests better than relying on unilateral action. In the long-term, multilateral controls can slow the spread of WMD while expanding markets for U.S.-made dual-use items.

The thesis focuses on the machine tool industry to clarify the issues raised by export controls. Because of their key role in most manufacturing processes, machine tools are critical capital equipment for industrialization. Their applicability to both military and civilian manufacturing makes many machine tools dual-use. In particular, multi-axis, computer numerically-controlled metal-cutting devices are essential in the production of nuclear weapons materials, missiles, and advanced aircraft. It is in both the security and the economic interests of the United States to maintain a competitive machine tool production capability. Therefore, a study of the impact of controls on the U.S. machine tool industry provides one means of evaluating export controls as a tool of foreign policy.

The best case available for examining the proliferation of WMD is Iraq. Since 1991, Iraq has been subjected to intrusive inspections of its WMD facilities and programs. The inspections have yielded valuable information regarding international procurement networks for sensitive technologies. International inspectors estimate that Iraq was only a few years from building a nuclear weapon, and many dual-use machine tools may have survived the war and the U.N. dismantling program. This thesis examines the role of the United States and other technology suppliers in Saddam Hussein's WMD programs.

The thesis finds that export controls on dual-use technologies are losing their ability to stem the spread of WMD, and that they are harmful to the relative competitiveness of machine tool producers when applied unilaterally. Multilateral controls contributed to the

demise of the Soviet Union by denying the communist bloc critical capital equipment and the means of matching the West militarily. However, without the bipolar international system, the leadership role of the United States in multilateral regimes has changed and international consensus for policy is more difficult to sustain. This thesis argues that the United States, as the sole superpower, has the ability and resources to re-establish an effective multilateral regime for controlling dual-use exports. Such a regime is in the long-term interests of the United States, but would require a substantial political and financial investment. The assessment of the costs and benefits of export controls has been elusive because of inadequate accounting measures at both the U.S. government and corporate levels. A better system of analyzing license application data, lost business opportunities, and the returns to security from nonproliferation programs is needed to weigh the value of controls. In addition, since export controls cannot prevent the spread of sensitive technologies to states determined to acquire WMD, a better means of monitoring technology diffusion is needed. This requires a complex information system for data-sharing, pre-notification of shipment, end-user verification, and license denials.

The United States alone may have the intelligence resources and the power to establish an effective system and enforce its rules. Prescriptions call for strong controls on a limited list of sensitive technologies and firm policies against rogue behavior. The United States must ensure positive incentives are included in the rules, as in the Nuclear Nonproliferation Treaty, to draw states into a verifiable, cooperative posture with regard to nonproliferation. Firm but fair leadership of multilateral efforts must reflect the position of the United States as the world's sole superpower.

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I. INTRODUCTION

> A central goal of our national security strategy is to promote America's prosperity through efforts both at home and abroad. Our economic and security interests are increasingly inseparable. Our prosperity at home depends on engaging actively abroad. The strength of our diplomacy, our ability to maintain an unrivaled military, the attractiveness of our values abroad -- all these depend in part on the strength of our economy.
>
> *A National Security Strategy of Engagement and Enlargement*[1]

A. FRAMEWORK OF ISSUES AND METHODOLOGY

The current trend in U.S. politics is to restrict government involvement overseas. To many Americans, U.S. support for supranational organizations such as the United Nations and the World Trade Organization are a waste of national resources which could be put to better use solving problems like crime or unemployment at home. Americans believe their national defense at last safe; the new enemy to their well-being is the large budget deficit, which threatens the nation's economic security, and an unnecessarily large government apparatus. These legacies of the Cold War are the targets of an inwardly-focused Congress which, in mid-1995, pushes to cut foreign aid and agencies at an increasing rate.

However, the threat from the proliferation of weapons of mass destruction (WMD) is increasing as defense production becomes more global. Controls on the transfers of military and dual-use technologies are losing their effectiveness in preventing the spread of WMD. The roles of multilateral export controls and of the United States in leading the regimes have changed since the end of the Cold War. The multilateral regimes require committed experts in the areas of commerce and security who work to slow proliferation of

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[1] *A National Security Strategy of Engagement and Enlargement*, (Washington, DC: The White House, February 1995), p. 19.

WMD, while supporting the prudent expansion of international trade. This paper argues that the United States should build on the power it bought during the Cold War by strengthening its leadership of multilateral regimes, and in particular the multilateral export control system.

This introductory chapter outlines the issues to be developed in later chapters regarding nonproliferation and industrial competitiveness. It introduces the current dialog about regimes of export controls of sensitive and dual-use technologies, covered more fully in Chapt. II. It then describes export control regimes and arrangements and their influence on trends in the machine tool industry in Chapt. III. Finally, it relates the lessons learned about the failures of controls in the case of Iraq, which is discussed in detail in Chapt. IV.

As this thesis examines the tradeoff between nonproliferation policy and industrial competitiveness, its purpose is to develop a perspective toward dual-use export controls which seeks to balance the concerns of exporters with those of proponents of stronger nonproliferation policies. The export control debate is politically-charged and fraught with obstacles reflecting opposing value systems. This section frames the issues and arguments, and develops the methodology to be followed in later chapters. The thesis asks the following questions: 1) How does U.S. export control policy, including participation in multilateral export control regimes, affect the competitiveness of the American dual-use machine tool industry? 2) How does the competitiveness of U.S. machine tool firms impact national security? 3) What are the proximate and ultimate national interests at stake?

B. THE NONPROLIFERATION-COMPETITIVENESS TRADEOFF

The control of sensitive and destabilizing weapons and technologies has long been a keystone in U.S. national security policy.[2] However, these controls pose significant tradeoffs. On the one hand, controls can help to keep weapons and enabling technologies out of the hands of potential adversaries. This enhances U.S. national security. On the other hand, controls of exports can reduce the profitability and competitiveness of American firms by limiting potential markets. The controlled exporting firms either lose market share to foreign competitors or lose the advantages of greater economies of scale. This can cost Americans jobs and erode the vitality of the industrial base. In some strategic sectors, this too could harm national security.[3]

The control of exports of military technologies and materials involves this tradeoff. However, it can be argued that the exporters who choose to do business in these sectors must be willing to accept the costs of the inherent restrictions on their trade. Still, in the military sectors, export controls are often offset by subsidies, large U.S. acquisition contracts, and

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[2]For discussions of the importance of nonproliferation to U.S. security policy, see the following: *A National Security Strategy of Engagement and Enlargement*, (Washington, DC:The White House, February 1995); Les Aspin, *Report on the Bottom-Up Review*, (Washington, DC: Department of Defense, October 1993); and Kim R. Holmes, ed., *A Safe and Prosperous America: A U.S. Foreign and Defense Policy Blueprint*, (Washington, DC: The Heritage Foundation, June 1994).

[3]Certain high technology industries, such as computer sectors, provide the U.S. military with an important edge. Secretary of Defense Perry has argued for the Clinton Administration that relaxing controls was justified to reduce burdens on these sectors, for which the military is an important but not dominant customer. See U.S. Congress, Office of Technology Assessment, *Export Controls and Nonproliferation Policy, OTA-ISS-596*, (Washington, DC: U.S. Government Printing Office, May 1994), p. 30. (This source is referred to as "OTA" in later footnotes.)

other forms of trade-distorting protectionism conducted in the interests of national security.[4]

The tradeoff is more problematic when it involves "dual-use" items. Dual-use technologies are those which have both military and civilian applications. In some cases, such as in nuclear technologies, the need to control the spread of the military application is apparent and broadly supported worldwide.[5] However, the legitimate application of nuclear technology for peaceful energy programs is important to the economic development of much of the world. Economic development is in the interest of the United States when it means expanded markets for American goods and services, enlargement of democratic movements encouraged by economic empowerment, and the stabilization of friendly regimes in volatile regions. The function of export controls is to limit the spread of military technologies, while providing an environment where legitimate technological development of civilian sectors can proceed. The Nuclear Nonproliferation Treaty (NPT) accomplishes this by providing for nuclear technology transfer to developing nations which forego nuclear weapons programs. The United Nations and the International Atomic Energy Agency serve to verify compliance through inspections and assistance.

One significant problem in dual-use technology exports is that there is no worldwide

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[4]For an argument that protectionism may increase as the new international system sorts itself out, see Steve Weber and John Zysman,"The Risk That Mercantilism Will Define the Next Security System" in Wayne Sandholtz et al., *The Highest Stakes: The Economic Foundations of the Next Security System,* Berkeley Roundtable on the International Economy (BRIE), (Oxford: Oxford University Press, 1992), pp. 167-196.

[5]Agreement was reached at the 1995 conference to extend the Nuclear Nonproliferation Treaty (NPT) indefinitely. Though driven by different issues than the nuclear treaty, conventions focusing on biological and chemical weapons resulted in similarly broad support for the Biological Weapons Convention (BWC) and the Chemical Weapons Convention (CWC).

consensus on what should be controlled. The debate quickly turns to technical descriptions of the degree of precision and the extent of process technology required to produce weapons of mass destruction (e.g., in the production of weapons-grade fissionable material) or their delivery systems (missiles, artillery shells, bombs, or aircraft).[6] The U.S. Department of Commerce, which administers export controls through its Bureau of Export Administration (BXA), employs a Commerce Control List (CCL) to categorize items deemed sensitive in both multilateral regimes and in unilateral U.S. policies.[7] This list is constantly the subject of debate between firms trying to increase their exports, and other groups which perceive that loopholes allow rogue states to acquire sensitive items.[8] The former want the list reduced, while the latter groups push for expanded and stricter restrictions.

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[6]The technical debates rage within the United States as well. For a summary of many key issues raised at a workshop held at Stanford University, October 18-19, 1993, see Cameron Binkley and John R. Harvey, *Export Controls on Dual-Use, High Technology: Implications for National/Economic Security*, A Working Paper of the Center for International Security and Arms Control, (Stanford University, December 1993).

[7]Determining which technologies are destabilizing and why has been problematic because of the rapid developments in automation, telecommunications, guidance systems, and many other fields which are critical for strategic and tactical military advantage. For a list of categories, see *Critical Technologies Plan*, (Washington, DC: Department of Defense, ES-2, 15 March 1991), and Rep. Tim Valentine, *Critical Technology: OSTP Report*, (Washington, DC: Congress, House Committee on Science, Space, and Technology, Subcommittee on Technology and Competitiveness, 102nd Congress, 1st sess. 25 April 1991).

[8]The Association of Manufacturing Technologies is an example of a group lobbying for looser controls. It is the national trade association for the U.S. machine tool industry. Institutions in government and academia which analyze security issues tend to advocate strong controls. Examples are the BXA, the Office of the Undersecretary of State for Arms Control and International Security Affairs (currently headed by Lynn Davis), and the Monitoring Proliferation Threats Project at the Monterey Institute of International Studies.

C. EXPORT CONTROL REGIMES

Advanced technologies are controlled both to retain American competitive advantage and to retard proliferation. During the Cold War, controls were a tool of economic statecraft to guarantee Western technological superiority over the communists. Following WW II, the West established COCOM. It served two security functions: it made key technologies for the production of threatening weapons unavailable to communist states; and it withheld machines necessary for the communist states' economic development.[9]

COCOM achieved general consensus among Western industrial states because of the clear bipolar international system. The various participants in the regime were generally able to cooperate despite having divergent national agendas. Under American leadership, the regime ultimately succeeded in speeding the demise of the Soviet bloc. The Soviet Union's economic system could not compensate for its technological isolation from the global capitalist market.[10]

The Soviet Union's collapse vindicated COCOM, but it also made the regime irrelevant. COCOM became obsolete as the West began to welcome the former Eastern bloc into the global market economy. Therefore in March 1994, COCOM ended. The members are reassessing the need for controls on new lists of dual-use technologies whose spread threatens international security. The new regime involves participation from the former Eastern bloc.[11]

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[9]Michael Mastanduno, *Economic Containment: COCOM and the Politics of East-West Trade*. (Ithaca: Cornell University Press, 1992), p. 64.

[10]National Academies of Sciences and Engineering, Institutes of Medicine, *Finding Common Ground: U.S. Export Controls in Changed Global Environment* (Washington, DC: National Academy Press, 1991), pp. 61-105.

[11]OTA, 1994, p. 49.

The United States participates in several multilateral regimes which focus on curbing the proliferation of missiles and weapons of mass destruction, including the Missile Technology Control Regime (MTCR), the Australia Group (focusing on chemical and biological weapons), and the Nuclear Suppliers' Group (NSG). They remain in force because their nonproliferation aims and requirements are less contentious than the rules for dual-use items.[12]

The leadership of the United States in the multilateral regimes is often reflected in the manner that the international controls resemble U.S. unilateral efforts. Proponents of unilateral controls cite that the principles of American nonproliferation policy formed the basis of COCOM's and the other regimes' effectiveness. In the bipolar world, U.S. allies either concurred with the wisdom of controls, or the United States pressured them to cooperate.[13]

In the absence of multilateral consensus, the United States continues to employ diverse means of export control. An example of other unilateral means of controls involving foreign policy is the President's use of executive orders, such as the recent decision by President Clinton to block Conoco's development of off-shore oil fields for Iran.[14]

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[12]OTA, 1994, pp.4-5.

[13]For examples of the effects of U.S. leadership, see the following: "The United States and Multilateral Export Control Regimes," Panel on the Future Design and Implementation of U.S. National Security Export Controls, (National Academies of Sciences and Engineering, Institutes of Medicine), *Finding Common Ground: U.S. Export Controls in a Changed Global Environment* (Washington, DC: National Academy Press, 1991), pp. 61-105; also Michael Mastanduno, "U.S. Leadership and the Struggle to Strengthen COCOM, 1981-89, in Mastanduno, *Economic Containment: COCOM and the Politics of East-West Trade*, (Ithaca: Cornell University Press, 1992), chapter 8.

[14]The problematic aspect of having a broad range of unilateral options is that some may undermine others. For example, a punitive sanction against Iran which aims at denying them access to civilian nuclear technology for energy reactors contrasts with simultaneous efforts to give North Korea nuclear technology to "civilianize" its nuclear program.

D. UNILATERALISM AND MULTILATERALISM

Simply blocking exports of destabilizing American technologies is an effective means of controlling proliferation when alternative sources are not available. Unilateral export controls are sufficient in such cases. However, in today's global economy, technology diffuses rapidly via Multinational Corporations (MNCs), joint ventures, offsets linked to licensing deals, reverse engineering, scientist exchanges, and by many other means. States seeking WMD can turn to non-U.S. sources for technical items and expertise. Thus for most technologies, unilateral U.S. export controls are of limited effectiveness in restricting access to items. In these situations, multilateral arrangements or regimes limit availability of items much better.

Two of the disadvantages of multilateralism are: 1) the large political and financial investment required to achieve international consensus and effective enforcement of controls; 2) the loss of sovereignty involved with any binding transnational regime. These problems will be discussed in more detail in Chapt. III.

E. U.S. HEGEMONY AND NATIONAL INTERESTS

The U.S. willingness to lead a multilateral effort to control the spread of sensitive technology reflects the importance it ascribes to this facet of nonproliferation. The question of export controls is a question of national interest. As the sole superpower in the international system, the United States wields considerable influence. This study assumes the United States can lead a multilateral effort to legislate policy which coincides with its national interests. An alternative assumption is that there is enough inertia in the system to support multilateral control regimes without a clear hegemon. However, the longevity of this arrangement depends on the "residue of common interests or social purposes among the dominant powers."[15] At the very least, the United States has to work beside the emerging powers to ensure our common interests are not compromised.[16]

The U.S. national interests at stake in the dual-use export control debate are complex. The long-term issues at stake when considering the spread of technology and WMD are: regional stability, threats to allies, collective security, open lines of communication and commerce, U.S. access to export markets and strategic resources, and democratization led by economic development.[17] Government spending trends, presented in Chapt. IV, suggest

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[15]Robert Gilpin, *The Political Economy of International Relations* (Princeton: Princeton University Press, 1987) p. 79.

[16]The leadership of the United States is a stabilizing influence for the international system, and critical for the functioning of international regimes according to the theory of hegemonic stability. This theory was initially expressed by Charles Kindleberger, who argued that hegemonic leadership is essential to a stable world order. See Kindleberger, "Dominance and Leadership in the International Economy: Exploitation, Public Goods, and Free Rides," *International Studies Quarterly* (Summer 1981),Vol. 25, No. 3, pp. 242-254.

[17]For a structured treatment of U.S. national interests, see Holmes, 1994. pp. 5-12.

changes in the government's support of the machine tool industry over time. This reflects the relative importance the U.S. government placed on the industry under various export control regimes and political climates since World War II, and earlier.

F. THE U.S. MACHINE TOOL INDUSTRY

The U.S. machine tool industry is relatively small, following a long period of decline and a shift in leadership to Japan and Germany. Even with less than $4 billion in total sales industry-wide, this sector has often drawn the attention of analysts and policy-makers as a "critical technology industry."[18] Machine tools are necessary for the production of other tools and product-forming equipment (such as molds for plastic goods) which drive most other manufacturing processes. Advances in machine tools lead directly to innovations in manufacturing technologies along the spectrum of civilian and military industries. Therefore the health of the machine tool industry affects the health of a very broad industrial base.[19]

Policy-makers recognize that foreign machine tool producers do not export their most advanced and innovative designs for one and a half to two years after marketing them domestically. This provides the foreign producers closer access to customers in order to "debug" the new product lines. The subsequent lag to U.S. industries which depend on imported technology has a profound and cascading affect on their ability to innovate processes. The result is a weakening of U.S. manufacturing competitiveness relative to the

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[18]See David Finegold et al., *The Decline of the U.S. Machine-Tool Industry and Prospects for Its Sustainable Recovery, Vol. 1* (Santa Monica: Rand, 1994), p. 1.

[19]James Mack, Vice President, Government Relations, Association for Manufacturing Technology, McLean, Virginia. Telephone interview. March 14, 1995.

foreign firms.[20] Since the national defense is intimately related to technological advantage, it can be concluded that weakness in the U.S. machine tool industry carries strong implications for national security.

The U.S. government has long supported research and development in machine tool technology to guarantee capacity for war. However, the government's efforts were insufficient to prevent a rapid erosion of the domestic machine tool industry in the 1980s as both demand and imports surged. Recent analyses suggest that the remaining U.S. machine tool producers are highly competitive, but there are still structural weaknesses in the industry. These weaknesses warn that the United States may have trouble sustaining a superior defense production base without more and better machine tool makers.[21]

The pattern of demand and sales of machine tools has followed the cycles of military conflict since WWI. War creates huge demand for machines for precision milling, grinding, boring, chucking, and lathing. While the Department of Defense buys some machines, most are purchased during the boom cycles by defense contractors. When the conflict subsides, demand falls. The fluctuation is cited as one of the major reasons for the decline in the American machine tool industry, because firms dependent on domestic sales failed to sustain operations in the peacetime market.[22] The dependence of the machine tool industry on military spending cycles was not as dramatic in Japan and Germany, where defense spending represented a smaller fraction of the GDP after WWII than in the United States. Government

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[20]Finegold et al., 1994, p.2.

[21]Finegold et al., 1994, pp. 2-3.

[22]DiFilippo, pp. 97-98.

spending policies in the United States tried to adjust for the effect of the business cycle by sustaining a permanent war economy after the Korean conflict. However, U.S. firms still did not generate enough civilian demand during subsequent recessionary periods. Machine tool demand was also hurt by competition from post-conflict sales of used military tool inventories. Thus analysts conclude that the Keynesian-military spending efforts to regulate business cycles and machine tool demand had a counterproductive effect on industry competitiveness.[23]

Concern for the competitiveness of the sector focused on support of research and development. The government historically funded independent industrial R&D only if it was directly applicable to a defense mission. With the National Cooperative Research Act of 1984, the government established funding for consortia of companies to develop basic technologies. One of these consortia is the National Center for Manufacturing Sciences (NCMS), which includes machine tool companies. Among their cooperative projects is advanced research on computer numerically-controlled (CNC) machines.[24]

G. MACHINE TOOLS AND EXPORT CONTROLS

While they comprise an important political tool , strong U.S. export controls are cited as the most important external obstacle to machine tool exports. Strict regulations, enforced by a "decentralized, uncoordinated interagency bureaucracy", have impeded foreign sales.[25]

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[23]Anthony DiFilippo, *Military Spending and Industrial Decline: A Study of the American Machine Tool Industry* (New York: Greenwood Press, 1986), p. 9.

[24]Finegold et al., 1994, p. 101.

[25]Finegold et al., 1994, p. 69.

Industry officials complain that the real problem is that the playing field is not level. While Japan, Germany, and most other industrialized states limit exports based on COCOM commodity control lists, the United States imposes additional controls based on more restrictive interpretations of the rules and on a series of export administration acts. Because of the distinct manner in which the United States adheres to the multilateral rules, the industry officials refer to the American government's attitude as "accidental unilateralism."[26]

Looser interpretations of the rules by the Germans and Japanese have resulted in those two countries' strong sales figures to the Soviet Union and China, respectively.[27] This occurred during the 1980s, when COCOM restrictions against Communist states were still in effect. The exports supported those countries' machine tool sales while the U.S. industry was in steep decline.[28]

Also, the process of reviewing requests for export licenses usually takes six to nine months (and often up to a year) in the United States, while it takes only weeks or days in Japan, Germany, and other machine tool exporting countries. Those countries enforce the multilateral rules much more quickly, and as a result win overseas contracts away from U.S. firms. Brian McCloud of Fadal Engineering declared that the red tape involved in the licensing process has dissuaded him from seeking overseas sales in most cases. He claims his company would expand exports overnight if the licensing process were no more cumbersome

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[26]Mack, 1995, and Brian McCloud, Director, Sales & Distribution, Fadal Engineering Co., Inc. Chatsworth, California, Telephone interview, March 14, 1995.

[27]See Finegold et al., 1994, pp.70-71, Figs. 4.22, 4.23.

[28]Finegold et al., 1994, p. 70.

than it is for his competitors in Japan. The United States requires requests to be reviewed by numerous sub-agencies within the Departments of Commerce, State, Defense, and Energy. The license requirement and accompanying review process apply to all machine tools sold overseas, regardless of sophistication.

A Rand study has recommended an overhaul of the license review process to reflect the current realities of international politics and global economic competition.[29] Ways to streamline the procedure include eliminating controls on less advanced machines and instituting a time limit for licensing. The latter measure forces the Department of Commerce to provide timely reasons why sales should not proceed. Special Agent Randall Sike[30] believes the regulations are already written more in favor of dual-use exporters than to support nonproliferation policies. He also believes the Clinton Administration supports business interests at least as much as previous Republican administrations did.[31]

While this view is shared by James Mack of the Association of Manufacturing Technologies[32], he believes the advantages of support from the Administration are enjoyed by the telecommunications and computer sectors, but not by the machine tool producers.[33]

James Mack argues that the unilateral export control policies of the United States have

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[29]Finegold, p.125.

[30]Of the San Jose Branch of the Bureau of Export Enforcement.

[31]Randall S. Sike, Special Agent In Charge, U.S. Department of Commerce, Office of Export Enforcement. Interview. San Jose, California. February 24, 1995.

[32]The national trade association for the machine tool industry; it was formerly known as the National Machine Tool Builders' Association.

[33]Mack, 1995.

only harmed U.S. exporters. He reports seeing precise 5-axis CNC machine tools on display by foreign companies at trade shows in China. The trde laws of the United States prohibit the export of 5-axis tools because they are deemed to provide greater capability to produce WMD components and materials, but they are clearly available on the international market.[34] Brian McCloud explains that most U.S. producers support restricting access of the sensitive technology to "rogue" states, but the U.S. laws block a much larger target market. He believes this market is wide open to foreign producers.[35] Mack and McCloud concur that the policies of U.S. agencies are in conflict. They citeas an example the case in which McDonnell-Douglas' advanced aircraft are being sold under U.S. government-supported license to China, which is already a nuclear power, while the machine tools used for building and servicing aircraft parts are being blocked.[36] Such barriers to the tool exports appear to serve no purpose for nonproliferation, since both WMD and aircraft delivery systems are otherwise available to the Chinese.

H. PRESCRIPTIONS FOR PROGRESS

The most fruitful way to implement export controls on dual-use machine tools may be to provide positive incentives and opportunities to the economic sectors affected. Straight compensation to exporters for losses of sales is not feasible, since no government can afford to make such payments, and because the determination of pecuniary loss would involve contentious guesswork. There are many other options that take advantage of market forces

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[34]Mack, 1995.

[35]McCloud, 1995.

[36]Mack, 1995.

and allow entrepreneurs to continue with business.

For example, the Nuclear Suppliers' Group, operating under NPT guidelines, provides for the transfer of nuclear energy technology to states for peaceful purposes if they comply with nonproliferation rules. That is, states are rewarded with technology if they do not engage in nuclear weapons programs or re-export the technology to states which might try to develop weapons. This is a powerful incentive for countries which need technology transfer for economic development to comply with NPT guidelines.[37]

The same system of positive incentives is feasible for dual-use items. Furthermore, it involves a broader group of states. The demand for precision machine tools is greater than for nuclear technologies, and there is a larger pool of source countries. The difficulty in implementing such a system is in administering the "end-user" procedures. Recipient states and exporters must guarantee the technology will not be used for military (especially WMD) purposes or be re-exported to states deemed to be likely to engage in WMD development. This process is extremely difficult to enforce. It requires a bureaucracy of inspectors as well as a system of information-sharing across national agencies and international borders, and a fair system of enforcement sanctions.

So far, the requirements listed have been obstacles preventing the positive-incentive approach from being widely applied. Instead, attention has focused on building "higher walls around fewer items."[38] The United States has not yet been able to assemble a list of items

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[37]OTA, 1994, p. 43.

[38]That is, tighter export restrictions on a shorter list of commodities and technologies. Sike, 1995.

it most wishes to control. As a result, it has not been able to guide the international negotiations for a COCOM successor effectively.[39] In the absence of a clear list of destabilizing items and a classification system based on objective criteria, the United States may be cautiously controlling too much. The result is excessive damage to our domestic industry and a weakened U.S. posture at the multilateral bargaining table.[40]

The benefits to international security of working through export control negotiations are potentially enormous. If the end-user system is improved and strengthened, it could bolster the integrity of supplier-recipient relationships. As a result, the potential markets for U.S. machine tool exporters might open and expand rapidly. As machine tool sales increase, so does general economic development. This eventually leads to the expansion of more markets overseas. The United States is well-positioned to profit from this expansion, hence our own industries and economy will grow.

Since the system of end-user verification is based on the voluntary eschewing of WMD by developing states, they may be more willing to turn to collective security regimes in order to stabilize their regional status. These states may pursue legitimate conventional weapons programs to provide for their security, which will leads to increased U.S. conventional arms sales and technology offset arrangements. The web of interdependence of states expands in such a scenario, with the United States in a favorable leadership position. This increases the

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[39]Mack, 1995. Mack refers to this as a search for the correct "modalities."

[40]Mack, 1995.

global influence of the United States, and decreases the likelihood of large-scale conflict.[41]

The system described above, beginning with export controls and leading to an expansion of trade, is based on positive incentives for both the suppliers and buyers. The system requires a great degree of transparency to ensure end-user compliance. Such transparency requires a sophisticated infrastructure of information-sharing and enforcement. Currently, most countries do not have the intelligence and automation assets to implement this type of export control system.[42] The United States would have to take the lead to establish infrastructure in many countries. It has already provided for an expanded database to monitor NSG activities, and can build on the effort for monitoring dual-use transfers.[43]

The long-term effects of such cooperative trade policies and technology transfer can build on themselves. As transparency, confidence, and development increase, so can security and investment. With greater security, political risk to business ventures decreases, and people may find more opportunities to translate improved economic status into political participation, thus "enlarging" democracy.

Obviously the reform of machine tool export controls will not solve all of this by itself. It is one important step in an international trade strategy of stability requiring a strong superpower/hegemon. Part of this prescription is the need for smart negotiating. James Mack points out that the United States is not negotiating like a hegemon. He cited a case in

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[41]"Cooperating" states will be less inclined to alienate the United States and the world community through aggressive acts, and "rogue" states will be deterred from projecting force by the prospect of opposing large international coalitions on the battlefield.

[42]OTA, 1994, p. 5.

[43]OTA, 1994, p. 5.

which Lynn Davis, Undersecretary of State for nonproliferation, entered negotiations for the successor regime to COCOM by declaring the U.S. has given up the right to a veto. Then she requested that the other countries concede on U.S. proposals for preshipment notification. They refused. While her efforts may have been principled, her tactics were weak, and the committee lost respect for U.S. leadership.[44]

I. THE CASE OF IRAQ

The arguments of this study can be applied very well in the case of Iraq. Under the dictatorship of Saddam Hussein, Iraq has sought preeminence in the Gulf region. Saddam has pursued WMD programs vigorously as a means to bolster security against real and perceived threats from Iran, Syria, and Israel. He also wants the power and prestige a WMD capability confers, in order to strengthen his bid to become the pan-Arab leader. Therefore, as a case of a state engaged in proliferation of WMD, Iraq provides valuable insights into both the need for export controls and their weaknesses.

Saddam's early efforts to acquire nuclear weapons involved the 1976 purchase of a French research reactor, installed at Osiraq. International outcry halted the initial contract for the French to transfer 72 kilograms of highly enriched uranium to Iraq. This blocked transfer fueled Saddam's desire to establish an indigenous enrichment capability. His plans to build WMD in Iraq required advanced machine tools and centrifuges.[45]

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[44]Mack, 1995.

[45]Suspected Mossad interventions terminated a 1979 transfer of a French reactor core and the life of an Egyptian nuclear scientist working for Saddam in Paris. In 1981, after Iran failed in its raid against the facility at Osiraq, the Israeli air force bombed the reactor. See Ephraim Karsh and I. Rautsi, *Saddam Hussein: A Political Biography* (London: Brassey's (UK), 1991), pp. 126-128.

Saddam's WMD programs accelerated during the 1980s, primarily aided by French and German technologies. Financially, Iraq was helped by the Gulf Cooperation Council (GCC) members and by the Atlanta office of the Banca Nazionale del Lavoro (BNL). Political support for the arming of Iraq came from the governments of the West and of the GCC, which regarded Saddam as the key line of defense against a revolutionary and expansionist Iran. The combination of these factors, together with a global procurement network, undermined existing military and dual-use export controls. The result was that Iraq developed and deployed chemical weapons against Iran and against its own Kurdish minority population, and it came dangerously close to building a nuclear weapon.

On August 2 and 9, 1990, immediately following Iraq's invasion of Kuwait, U.S. Executive Orders prohibited transactions with Iraq. Like Iran and Syria, Iraq is listed as "a nation that has repeatedly supported acts of international terrorism."[46] During the inspections and investigations conducted in accordnce with the terms of the 1990-91 Gulf War cease fire and U.N. resolutions, the importance of machine tools to the Iraqi WMD development effort became clearer. The diffusion of machine tools and technology resulted from violation and misapplication of export controls, and from legal transfers that violated the spirit of

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[46]See the *Export Administration Bulletin 282*, "Special Country Policies and Provisions", section 785.4, October 1994: "Pursuant to Executive Orders 12722 and 12724 of August 2 and August 9, 1990, respectively, the Department of Treasury's Office of Foreign assets Control (OFAC) has published regulations prohibiting transactions with the government of , and persons in, Iraq. The Iraqi Sanctions Regulations (31 C.F.R. section 575.205 of January 18, 1991) provide that 'no goods, technology (including technical data or other information), or services from the United States or, if subject to U.S. jurisdiction, exported or reexported from a third country to Iraq, to any entity owned or controlled by the Government of Iraq,' except as otherwise authorized. Absent any required OFAC license, no BXA general license or other authorization may be used for export to Iraq. An authorization from OFAC shall also constitute authorization under the Export Administration Regulations."

onproliferation. Chapter V examines the special case of Iraq in detail, focusing on lessons learned for dealing with other rogues in the region.

J. SUMMARY AND METHODOLOGY

The debate over export controls of dual-use technologies involves many core concerns for U.S. national security. Nonproliferation of weapons of mass destruction, industrial competitiveness and defense preparedness, the economic welfare of Americans, collective security and multilateral ordering regimes, and the sorting out of friends from rogues -- all strain the intellectual and material resources of the U.S. security apparatus. As with most domestic and foreign policies, progress in reforming export controls depends on applying a coherent and principled approach. Today, multilateral control regimes are not only prescribed, they are indispensable. But international consensus will come only if the United States leads the way. We cannot abdicate leadership without paying high costs in the long-term .As leaders, Americans must understand the critical roles of the other major industrial powers in the system -- namely Germany (and the European Union), Japan, and Russia-- and must work to integrate China, India, and the Newly Industrializing Countries (NICs). Rogues must be dealt with firmly, but also in a fair way if the United States intends to bring them around someday to join the cooperative regime. The essence of hegemonic power is to make national interests and global interests coincide. Dual-use machine tool export control policy offers the United States another opportunity to assert its leadership.

In this introductory chapter, the framework of the basic arguments and issues are spelled out briefly. Some of the arguments lead to policy prescriptions. They attempt to reconcile opposing viewpoints and take advantage of the common ground in order to enhance both

national security and industrial viability. The relationship between the dual-use machine tool industry and unilateral and multilateral export controls fuels the debate on nonproliferation and national security policy. This section attempts to clarify the relationship and establish a methodology for the thesis.

The thesis examines the tradeoff between industrial competitiveness and nonproliferation objectives. Its purpose is to develop a manner of thinking about export controls which balances the concerns of exporters with those of proponents of stronger nonproliferation policies.

The means of achieving that perspective is by examining the merits of unilateral and multilateral dual-use export controls as policy tools to enhance U.S. national security and economic security interests. In this examination, the objective is to identify the problems of measuring costs and benefits of various export control arrangements, and to suggest ways to improve the government's and exporters' means for evaluating controls more objectively.

The study focuses on the dual-use machine tool industry to clarify issues raised by export controls. Dual-usemachine tools are critical to both the U.S. defense apparatus and to the U.S. manufacturing base. It is in both the security and economic interests of the United States to maintain a competitive machine tool production capability. Therefore the study of the impact of controls on the U.S. machine tool industry provides one means of evaluatingexport controls as a tool of industrial and foreign policy.

The research considers cases of technology transfers to sensitive countries in the Middle East. To focus, the special case of Iraq is examined. Iraq is of singular value in the dialog on export controls because of the following factors: 1) it is one of a small number of

internationally recognized "rogue" states; 2) it pursued a vigorous program of developing WMDs in spite of multilateral control efforts designed to hinder it; 3) it is now subjected to extremely intrusive international inspections which reveal valuable information about its procurement efforts; 4) Iraq, as well as its regional rival Iran, may intend to continue to pursue WMD programs to change the balance of power in the sensitive Gulf region.

Following the discussion of the case of Iraq, the findings of the study and policy prescriptions are described in Chapter V.

II. EXPORT CONTROLS AND DUAL-USE TECHNOLOGIES

> ...a key part of our strategy is to seek to stem the proliferation of [weapons of mass destruction] and to develop an effective capability to deal with these threats...we also support improved export controls for nonproliferation purposes both domestically and multilaterally.
>
> *A National Security Strategy of Engagement and Enlargement*[47]

A. INTRODUCTION

Almost by definition, "nonproliferation" requires restrictions, i.e., controls, on the diffusion of sensitive items, systems, and technologies. Many analysts argue convincingly that export controls have lost a great deal of effectiveness since the end of the Cold War in the globalization of the defense industry.[48] However, as long as proliferation of WMD tops the list of threats to U.S. interests, export controls will be one of the policy tools used to slow WMD spread. Effectiveness depends on "the characteristics of the weapons of concern, the capabilities of the target countries and programs, the controllability of the designated commodities and technology, the degree of international cooperation, and the quality of enforcement."[49]

In most cases, controls represent a delay designed to allow implementation of other nonproliferation policy tools. In cases involving dual-use technologies, the trend will be to

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[47]*A National Security Strategy of Engagement and Enlargement,* (Washington, DC: The White House, February 1995), pp. 13-14.

[48]See David Mussington, *Arms Unbound*, 1994, p. 80, and Lieutenant Daniel M. Green, *Monitoring Technology Proliferation: An Open Source Methodology for Generating Proliferation Intelligence*, Master of Arts Thesis, (Monterey: Naval Postgraduate School, December 1993), pp. 5-6.

[49]OTA, 1994, p. 1.

identify the most sensitive dual-use commodities to WMD production and to apply the strongest controls possible. Meanwhile, most transfers of technology falling under the various multilateral or unilateral control arrangements will be monitored more closely to expose potential WMD proliferation activity.[50] The increasingly difficult task is designing controls that serve both security and economic interests.

B. EXPORT CONTROL REGIMES AND ARRANGEMENTS

There have been many multilateral and unilateral attempts to deal with the problem of proliferation. During the Cold War, the West formed COCOM, the Coordinating Committee for Multilateral Export Controls, to restrict the transfer of threatening technology to the communists and their client states. This arrangement was managed primarily by the G7 countries, who are now engaged in negotiations for a successor regime. The successor must be more relevant to the new purposes of controls given the collapse of communism. The successor may be revised to cover lists of products and technologies not covered in other multilateral regimes which deal specifically with WMD and missiles. The current concern is to ensure the COCOM successor does not undermine the consensus built in those other regimes. The lists of controlled items may be short and specific to speed consensus and ratification, and may focus on the question of dual-use machines and technologies.[51] The successor regime is to bring in as new members such supplier states as Russia and China, whose exports could seriously hamper efforts to slow the spread of WMD. Failure by the

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[50]See Daniel M. Green, *Monitoring Technology Proliferation,* for a proposal to increase the use of commercial information networks to aid in the tracking of WMD proliferation activity.

[51]OTA, 1994, p. 4.

former COCOM members to include them could be interpreted as a ploy to block them from cooperative trade arrangements, or as a U.S.-led effort to protect American competitiveness. The United States must be careful to emphasize that the true aims of nonproliferation agreements are to maximize international security. Thus it becomes a question of American political credibility and good faith to involve the Russians and Chinese.[52]

The former COCOM countries have indicated that COCOM's successor regime will include Russia and the other Eastern European states as founding members. It will be open to all countries which endorse non-proliferation norms and adhere to existing export control regimes other than COCOM.[53] The member countries must agree to implement an effective domestic export control system. The targets of the Forum will be states which refuse to sign on to nonproliferation norms or otherwise exhibit undesirable behavior.[54]

Coordination among members of multilateral export control regimes will depend upon communication and information sharing. Once the member nations have demonstrated their willingness to restrict threatening transfers, often at great cost to their exporting companies, the key to success will be the efficient passing of information. The United States has taken the lead in establishing a computer-based network for the members of the Nuclear Suppliers' Group (NSG). The NSG has agreed to common export control policies for nuclear and

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[52]"Meeting On Rocket Technology, Dual-Purpose Knowledge Export," *Central Eurasia*, January 4, 1993, p. 27.

[53]The members want to avoid undermining consensus built in the other regimes.

[54]For example, by sponsoring terrorism.

dual-use technologies.[55] Members share information about export license requests, approvals and denials, and end-user data. This network assists member countries which cannot afford extensive intelligence resources to support their export control programs. By raising awareness throughout the system, it strengthens barriers to the spread of WMD.

Similar networks will be extended to members of the Australia Group and the Missile Technology Control Regime (MTCR). The Australia Group is a multilateral arrangement focusing on chemical and biological weapons proliferation, while the MTCR focuses on ballistic missiles. Each of these two arrangements is concerned with an extensive array of dual-use technology. There is heavy pressure from industry on these regimes to relax restrictions and permit more exports, ostensibly for legitimate civilian projects.

The United States is continuing to refine its unilateral export control measures as well. The Bush administration tightened export controls under the Enhanced Proliferation Control Initiative (EPCI). The EPCI reviewed licenses for WMD technologies, placing what U.S. industry complained was an unfair burden on American exporters.[56] The Clinton Administration has been clarifying EPCI rules in a manner which is friendlier to industry, with the intent of harmonizing license review procedures with provisions of the multilateral agreements. The Administration's interpretations and provisions for controls and sanctions are spelled out in its draft Export Administration Act of 1994 (EAA). The major areas of concern in current U.S. unilateral efforts are the assessment and balancing of industrial costs with security goals, and the provisions for timely review of export requests by all appropriate

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[55]OTA, 1994, p. 5.

[56]OTA, 1994, p. 8.

Administration and Congressional agencies.

Unilateral controls are proving to be of reduced effectiveness in the post-Cold War era. The evolution in the structure of the international marketplace degrades the effectiveness of controls by making technology diffusion much easier. Multinational or transnational corporations (MNCs) disseminate the results of research and development, often to the countries outside of control regimes.

Those who argue for strong unilateral U.S. controls even in the presence of foreign availability, do so to strengthen other foreign policy efforts. The resolve of the United States in upholding principles of nonproliferation and terrorism provides leadership in world affairs. Other suppliers may be influenced to cooperate with U.S. policies in seeking changes in the behavior of target states.

Harvey et al. studied three cases of U.S. unilateralism: the Iran embargo and its impact on sales of commercial airliners, the "catch-all" provision of the Enhanced Proliferation Control Initiative, and stringent U.S. sanctions under the MTCR. In each case, the group found U.S. unilateralism to be counterproductive to overall economic and foreign policy interests. They recommended no further unilateral controls on dual-use items for which the U.S. is not the sole supplier.[57] They recognized that sometimes unilateralism follows political necessity, but they advocated including "sunset provisions" in such instances unless the controls become multilateral. This would entail periodic reviews of the controls. Harvey's team recommended revision or elimination of the EPCI, as well as broader discretion to the President to impose sanctions and to allow or ban specific exports to specific end-users,

[57]Harvey et al., 1995, p. xi.

according to national security or economic conditions.[58]

With regard to unilateral efforts, Harvey's group recommends that the U.S. should seek multilateral participation before imposing an embargo. Among the possibilities for trade sanctions, the United States could block imports from target countries or regions, especially when alternative sources of the imported goods are available.

With regard to multilateral export controls, Harvey's group predicts a continuing but weakened role for controls under the successor regime to COCOM, referred to as "The New Forum". These controls may be oriented exclusively toward nonproliferation goals, rather than toward other foreign or commercial policy objectives. This reflects that the most important goal to the New Forum is the controlling of the transfer of plutonium and highly enriched uranium, including the means of their production.[59]

C. THE U.S. EXPORT CONTROL SYSTEM SIMPLIFIED

Congress is reviewing legislation reforming the Export Administration Act (EAA). It gives the executive branch the most discretion among the U.S. government bodies in imposing controls, including broad powers of enforcement. The export administration act provides the key guidelines for licenses of dual-use exports. All U.S. exports require a license, indicating that exporting from the United States is more a privilege than a right. Most exports can be exported under a "general license". The Commerce Department's Bureau of Export

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[58]Harvey et al., 1995, p. xii.

[59]For example, the means of producing these fissionable materials include CNC machine tools and gas centrifuges.

Administration (BXA) regulates the licensing process.[60]

EAA authorizes Commerce to maintain Export Administration regulations (EAR) which contains the Commerce Control List (CCL). It is the exporter's responsibility to determine what licenses and procedures are appropriate and through which agencies they must apply. Controls are applied based on three factors: (1) the item's technical characteristics; (2) whether the export is equipment, a material, production-related information, or software[61]; (3) the item's destination.[62] The exporters usually find that their burdens lie in determining which license is needed,[63] in getting Commerce pre-approval to ship to a specific place, or in being informed, as required under the EPCI, as to whether a product's end-user is involved in proliferation activities.[64]

D. BENEFITS AND COSTS OF EXPORT CONTROLS

Proliferation of weapons of mass destruction stands at the top of the list of threats to the United States because of the immense costs associated with it. Hostile WMD use represents

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[60]The U.S. Department of Commerce controls the export of dual-use items under the Export administration Regulations (EAR). U.S. firms must consult with two separate offices within Commerce: the Strategic Trade and Foreign Policy Controls Office, Foreign Policy Controls Division, BXA; and Commerce Classifications Office, Office of Exporter Services, BXA. Export of strictly defense articles are handled by State: Office of Trade Controls and Office of Export Control Policy, Bureau of Political-Military Affairs.

[61]Machine tools can be both (1) and (2).

[62]Harvey et al., 1995, p. 72.

[63]Most high-technology exports require a "validated" license rather than the simpler general license.

[64]Harvey et al., 1995, p. 72. President Bush set forth the Enhanced Proliferation Control Initiative in December 1990. It required exporters to obtain government approval to ship to a destination which they "either know or are informed" is engaged in WMD proliferation.

a clear threat to millions of lives and billions of dollars in property. As was made clear during the Cold War, deterring or countering a known WMD threat costs billions of dollars in military preparations and civil defense. The bipolar arrangement between the United States and the former Soviet Union provided decades of tension, but for many realist thinkers, it was a relatively stable international system. The post-Cold War era involves regional and ideological antagonism that is less well understood, and therefore unsettling for American security planners. In such a climate, the costs associated with WMD proliferation increase disproportionately to the number of weapons faced. That is, a relatively small number of nuclear weapons in the hands of North Koreans, Iranians, Iraqis, Libyans, or some non-state actor (e.g., Palestinians or other political organizations) carries a higher cost to the United States, per weapon faced, than we experienced during the Cold War against the Soviets. That is because the level of uncertainty is higher in terms of U.S. policies and postures necessary to deter WMD use. Thus the cost of each incidence of WMD proliferation may be increasing in the less stable post-Cold War era. To the extent that export controls can be effective in slowing WMD proliferation, their costs to industry and exporters may be justified.

1. Benefits

The international community participates in export control regimes such as NPT, BWC, and CWC because of consensus with the premise that, if left to unrestrained market forces, WMD would be more cheaply and quickly acquired by those who seek them.

There would always be some structural barriers to the spread of WMD.[65] The potential

[65]For example, barriers include the level of technical and industrial development of the target country, the sophistication of the WMD devices sought, and the political will of the country's leaders to include WMD as part of their search for security, power, and/or prestige.

effectiveness of export controls involves those natural barriers. International cooperation on the part of suppliers can make destabilizing weapons and sensitive technologies prohibitively expensive. Access to key proprietary knowledge, learning institutions, and industrial technicians can be blocked. On the demand side, collective security arrangements and other diplomatic efforts can influence the target country's perceptions of its need to acquire WMD.

Also, other factors affect export control effectiveness. These include the degree of cooperation among suppliers in multilateral regimes, the successful implementation of enforcement policies, and the degree of general availability of dual-use items.[66] The degree of cooperation among suppliers represents a commitment in both spirit and resources. The participation in the multilateral rule-making is inseparable from the country's ability to pass its own national export control legislation, then to dedicate administrative and technical resources to the task of enforcement. At every step, the export control process can be undermined by corruption, incompetence, light penalties against violators, and lack of resourcing.

However, even with these weaknesses, export controls carry costs for states seeking WMD. In particular, nuclear weapons programs require large quantities of purified fissionable material, highly technical services and spare parts, and facilities designed for safety and secrecy. Controls that are even partially implemented add considerable cost and trouble to an illicit procurement effort. Therefore, even while a large number of factors can weaken efforts to control the spread of WMD, they have a demonstrable deterrent effect on some

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[66]OTA, p. 22.

nations.[67]

The Office of Technology Assessment suggests that it is probably impossible to quantify or even estimate qualitatively the effects of export controls on potential proliferants in terms of costs and delays.[68] These "costs" to proliferants represent a "benefit" to the greater international community, and specifically to the United States.[69] However, as great as the benefits can be portrayed, they are mostly intangible, long-term, and apply to everyone equally. In contrast, most of the costs of export controls are estimable in the short-term, and affect only selected industries, companies, and government agencies.

2. Costs

A rigorous assessment of the costs of export controls would consider both direct and indirect costs to government, industry, and individual citizens/consumers. The requirements of administration of a strong control regime can be extensive, especially considering that the goals of U.S. export controls are broader than merely supporting nonproliferation. The often conflicting goals of domestic and international commercial policies, as well as foreign and

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[67]Examples of deterrence may includethe following: South Africa, where they gave up on their nuclear weapons program after building six expensive weapons; Iraq, where the lack of delays to its nuclear weapons programs would have dramatically altered the outcome of Desert Shield and Desert Storm; and Argentina and Brazil, where the slowing of their programs by controls may have convinced them of the greater value in signing the NPT (OTA, p.25).

[68]OTA, 1994, p. 25.

[69]An exception to this situation is that of Israel, where proliferation of nuclear weapons technology and capability seems to have been in the interests of the United States. During the Cold War, The United States used its special relationship with Israel to counter perceived threats from the Soviet Union and other antagonists in the Middle East. However, Israel's nuclear status has become more problematic to the United States in its post-Cold War relations with the Arab and greater Muslim world.

diplomatic policies, complicate the export control process. Sorting out the priorities demands significant administrative capital from the government to avoid unnecessary damage to relations with either foreign governments or domestic industrial concerns. The process of weighing options on a case-by-case basis undermines the coherence of policy. In diplomacy, where "capital" represents trust-building, perceptions of relative power, support, and commitment, the costs of controls are impossible to quantify or isolate.

The economic costs to exporters are more direct and quantifiable, and therefore more contentious insofar as concrete arguments hold weight. Exporters attempt to quantify the amount of lost business that would have been conducted in the absence of controls. Denied export license applications give a partial measure. However, many firms assert that such a figure does not capture the bulk of transactions avoided because firms assumed a license would be denied. The firms also have to spend considerable amount on the tracking of and complying with regulations. It adds to costs and products less competitive than the products from suppliers subject to less burdensome rules. In the case of many smaller companies, such as some of the most innovative in the U.S. machine tool industry, meeting the requirements is so difficult and frustrating they do not even try to export, despite signs their products are competitive.

From a normative perspective, most U.S. companies do not want to violate U.S. and international nonproliferation codes because doing so brings bad publicity to their firms and hurts sales. Therefore even in the absence of export controls, exporters of military commodities pay attention to end-user standards. This is less clear in the case of dual-use

machine tools, where the international codes are not built on strong consensus.[70] Producers of dual-use technology have less normative information to use than do suppliers of nuclear materials or weapons technologies. Therefore, the calculation of these costs is more difficult to associate with export controls.

U.S. firms have often complained that they lose sales to other suppliers in the multinational regimes because of the more stringent interpretations of the rules by the United States government. Not only do the exporters lose the initial deals, but also any follow-on business that may have accompanied them. This implies, again, that statistics of lost exports via licensing data is understated. In his article, *Sizing Up U.S. Export Disincentives*, J. David Richardson attempted to assess the loss of U.S. exports to other members of COCOM. His findings "did not support the hypothesis that trade with COCOM partners was adversely affected".[71] Richardson also estimated that, under the COCOM regime, U.S. national security export controls on dual-use items to communist countries cost between $4.5 and $20 billion in 1989. His estimates for 1993 in testimony before Congress were $20-30 billion. As COCOM has declined in relevance and authority, relaxation of controls for computers and telecommunications products will reduce the estimates of such costs in the future.

The aggregate cost of export controls on the U.S. economy (balance of payments) is very small. Denied license applications amounted to 0.1% of total U.S. exports in 1992.[72] In a report ordered by Senator John Glenn (D-Ohio), Chairman of the Committee on

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[70]Mack, 1995.

[71]OTA , pp. 27-28.

[72]OTA, 1994, p. 29.

Governmental Affairs and one of the most active proponents of stronger export controls for dual-use items, the General Accounting Office stated 336,000 export licenses worth $264 billion were issued between FY 1985-92 for nuclear-related dual-use items. Of these, $29 billion worth went to 36 countries of proliferation concern. Over 24,000 licenses were approved for exports to eight countries seeking nuclear weapons, with an overall rejection rate to controlled countries of only one percent.[73]

3. Prescriptions

Both exporters and advocates for controls want a better system for assessing and reporting the economic impact of export controls. Impact reports should include sectoral and product details which measure the effects of controls on U.S. direct investment, on alliances abroad, and on foreign direct investment and alliances in the United States.[74] Use of license application data would have to be improved to allow the breakdown of data into component types and values. A means to compare controlled product types with data on categories tracked by the Bureau of the Census may also allow more rigorous analysis. Some means is needed to capture the value of lost or deterred business without including the heavy bias encountered when dealing with firms' perceptions. Also, the costs of firms' internal controls and administration add to the value of exports and must be weighed. Finally, a net assessment of costs of controls must consider the probability and cost associated with WMD

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[73]See the report to Sen John Glenn, Chairman of the Committee on Governmental Affairs, U.S. Senate, *Export Licensing Procedures for Dual-Use Items Need to be Strengthened,* April 1994, GAO/NSIAD-94-119.

[74]See J. David Richardson, *Economic Costs of U.S. Export Controls,*(Washington, DC: Statement before the Subcommittee on Economic Policy, Trade, and Environment, Committee on Foreign Affairs, U.S. House of Representatives, November 18, 1993), p. 12.

proliferation in the absence of controls. The cost-benefit analysis is desirable to all concerned, because the data will both support the call for reforms of controls which is more in line with the realities of the current international system, and it will provide for better monitoring of proliferation activity.[75]

[75]OTA, 1994, pp. 65-66.

III. THE DUAL-USE MACHINE TOOL INDUSTRY

> Practically every problem concerned with the production of arms and equipment, ships and planes, starts with the question of machine tools. The tool builders, therefore constitute the keystone of the entire procurement structure.
>
> George C. Marshall, Chief of Staff during WWII.[76]

A. INTRODUCTION

Machine tools are called "mother machines" because they give rise to a cascade of other capital equipment and manufacturing processes. Most machine tools are classed as either metal-cutting or metal-forming types. Basic functions of the former are turning, milling, planing, shaping, drilling, boring, grinding, and sawing. The latter punch, forge, shear, draw, and press metal in the shaping process.[77] The machine tools can be exotic, such as "the electrolytic", "electron-discharge", and "ultrasonic" metal-cutters. They can buff, polish, and burnish. They can extrude, file, groove, thread, slot, keyseat, and lathe. The most important dual-use machine tools for the production of nuclear materials, weapons, and delivery systems are the highly-precise, multiple axis, computer numerically controlled (CNC) tools.

While the industry is relatively small, it is considered critical to both the military and

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[76]The circumstances in which Marshall made this remark are unknown. Anthony DiFilippo, 1986, pp. 30, 37, cites First Vice President Henry D. Sharpe, Jr. of the National Machine Tool Builders' Association as using the quote during testimony before the House Ways and Means Committee on June 4, 1970.

[77]For an analysis of structural problems and decline, see Anthony DiFilippo's *Military Spending and Industrial Decline: A Study Of The American Machine Tool Industry* (New York: Greenwood Press, 1986). Also see Finegold et al., *The Decline of the U.S. Machine Tool Industry and Prospects for Its Sustainable Recovery*, Vols. 1 & 2 (Appendices), (Santa Monica: Rand, 1994). As DiFilippo's study is from before the end of the Cold War, and during the period of high defense spending, it does not have the advantages of the Rand study in observing the early stages of restructuring and improvement.

economic security of the United States. Its health has been the subject of extensive study during the 1980s, when it was in rapid decline, and in the 1990s, when restructuring and recovery are taking place slowly.[78]

B. THE DECLINE OF THE U.S. MACHINE TOOL INDUSTRY

DiFilippo (1986) argued that high U.S. government spending on defense has hurt industry over the years. He explains that the United States maintained a permanent war economy after WWII, especially after the Korean War and conspicuous Soviet advances in Nuclear capability. Government expenditures in the United States for defense, as a percent of Gross Domestic Product, was almost 80 times that in Japan in the mid 1960s.[79] The result of this was that the industries of other nations were less focused on military applications of their technologies, and more concerned with commercial competitiveness. While indispensable to defense production, the machine tool industry was not centrally located within the military-industrial complex, as were the missile and aerospace industries. According to DiFilippo, the government did not spend enough on machine tool R&D, and remained largely uncooperative with the industry in regard to technological assistance for commercial applications.[80]

Sporadic "military Keynesianism", marked by widely fluctuating defense expenditures, distorted the domestic market for machine tools throughout most of the post-WWII period.

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[78]Monthly statistics of machine tool orders represent an important indicator of capital spending by manufacturing companies, and therefore one of the earliest macroeconomic indicators of future economic activity. See Raju Narisetti, "March Machine Tool Orders Rose 47%, Highlighting Robust Capital Spending", *Wall Street Journal*, April 24, 1995, p. A 14.

[79]DiFilippo, 1986, p. 2.

[80]DiFilippo, 1986, p. 3.

As mentioned in Chapt. I, this caused greater sensitivity to the business cycle and depressed R&D spending further. In many respects, a war economy is the antithesis of the private sector, because it erodes the free market forces which enhance productivity, efficiency, and technical competence. Thus for DiFilippo, there is an inverse relationship between high long-term defense spending in the United States and competitiveness. Resources in competitor nations, such as Japan and West Germany, were free to R&D of civilian technologies. The president of the National Machine Tool Builders' Association noted in 1979 that the government of Japan "takes a very paternalistic view of the private sector to develop and promote new exportable products through the Ministry of International Trade and Industry (MITI)."[81] During much of the Cold War, then, the absence of defense spending led to closer ties between foreign governments and their countries' machine tool builders than was found in the United States.

Another impediment to the U.S. machine tool industry, which was caused by the primacy of the defense apparatus in the United States, was a heightened concern for export controls.[82] As the leader and protector of the free world, the United States placed a higher priority on defense imperatives than other capitalist countries did. Therefore, restriction of overseas markets and over-reliance on the fluctuating demands of the defense sector have violated

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[81]DiFilippo, 1986, p. 8.

[82]It was in response to the growing threat posed by the Soviets that export controls were imposed. See Mastanduno, 1992, for a description of the establishment and development of COCOM under U.S. leadership.

basic principles of free enterprise for the industry, and led to decline.[83]

C. THE U.S. MACHINE TOOL INDUSTRY AND THE MILITARY: A HISTORY OF INTERDEPENDENCE

The special relationship between the machine tool industry and the U.S. military can be traced to arms contracts for muskets and pistols with interchangeable parts. Eli Whitney (1798), Simeon North (1799, 1813), and John Hall (1816), employed early machine tools to provide such arms for the young nation's arsenals. The Civil War increased machine tool demand enormously in both the United States and Great Britain, hastening technical improvements.

The United States machine tool industry established itself as the world quality leader in the late 19th century, and exports sustained U.S. firms during periods of domestic economic contraction.[84] The automobile industry eclipsed defense as the major consumer of machine tools until WWI, when defense orders regained the lead (primarily in Europe until the United States was committed to the war). Huge growth in sales and capacity during the war was followed by a decline after the armistice, though the industry was buoyed somewhat by robust automobile and aircraft sectors until the Depression.

By then the cyclical nature of the machine tool business had been frequently demonstrated, which prevented investors from venturing capital in the industry. This reduced the amount available for R&D, and left toolmakers less proactive in finding innovative designs.

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[83]The structural causes of the decline are explained in detail in DiFilippo, 1986, Chapter 3, and in Finegold et al., 1994. pp. 15-20.

[84]DiFilippo, 1986, p. 19.

By the late 1930s, the U.S. government's orders for military aircraft and surging exports to belligerants in Europe revitalized the industry. Also, a thriving automobile industry benefited machine tool companies. During WWII, the foremost manufacturing sector in America was military aircraft, which was using over 276,000 machine tools.[85] The effect of WWII was to embed in the minds of machine tool producers the idea of a close strategic relationship between the military sector and the machine tool industry. During WWII, they built over one million machine tools for defense contractors.[86] Shipments increased sixfold from 1940-1945, with the vast majority of tools sold and used domestically.

After WWII, many of the still new tools were not needed by the shrinking defense sector, and there was a glut of tools on the market from both public and private sectors. The industrial slump persisted until the Korean War. Thus the machine tool industry had become dependent on military spending and military demand. Economic contractions in the United States represented the greatest threat to tool sales, but were usually mitigated by exports in the first half of the 20th Century, due to the superior quality of American tools, and the absence of export controls.[87]

D. THE ECONOMIC COSTS OF EXPORT CONTROLS ON THE MACHINE TOOL INDUSTRY

Efforts to quantify the aggregate economic costs of controls on a specific industry have usually depended on Department of Commerce (DOC) license application data. However,

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[85]DiFilippo, 1986, p. 29.

[86]DiFilippo, 1986, p. 30.

[87]Difilippo, 1986, p. 34.

as discussed above, companies' decisions to apply for Individual Validated Licenses (IVL) do not capture all the effects of controls on firm's decisions and sales. The data DOC collects is not in a form that lends itself to analysis, since it is not possible to distinguish product types within collective license applications. Also, Export Control Classification Numbers are not related to other trade statistics (kept by the Bureau of the Census's export and import record system). Thus license application data offers dubious information about impacts on specific sectors.[88]

A 1994 report prepared by the Office of Technology Assessment attempts to illustrate the problem of using license data by focusing on the machine tool case. The report points out that the numerically-controlled or computer-numerically -controlled (CNC) machine tools of certain performance specifications appear on the Commerce Control List (CCL) for both nuclear and missile nonproliferation reasons.[89] They also appear on the CCL because of the national security reasons characterized by COCOM. That is, they were controlled for reasons associated with economic statecraft.[90]

The GAO report to Senator John Glenn entitled *Export Licensing Procedures for Dual-Use Items Need To Be Strengthened* (1994) suggests that very few applications for exports of dual-use machine tools are rejected by the Commerce Department. A specific example of a license approval from late 1989 involves a military end-user in Pakistan who received two

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[88]OTA, 1994, p. 68.

[89]OTA, 1994, p. 68.

[90]The intent of COCOM was to deny the Communists enabling technologies for both weapons/military applications and for general economic development. The latter reason is still behind much of the punitive U.S. trade policies against Cuba, Iran, Iraq, Libya, and North Korea.

four-axis grinding machines capable of manufacturing critical nuclear weapons components. In spite of being identified by the Department of Energy's Nuclear Proliferation Watch List as engaged in "sensitive nuclear activities" (the design, manufacture, or testing of nuclear weapons or the special nuclear material production), the customer's license was approved "on the condition that the exporter provide the SNEC with periodic reports on the status of the item; however, according to Commerce officials, no such reports have ever been provided."[91] The $1.5 million grinding machine sale was approved even after the SNEC recommended blocking the end user from less valuable NRL licenses.

E. MACHINE TOOL DEMAND AND MILITARY SPENDING

While the largest consumers of U.S.-made machine tools are private sector nonelectrical machinery, fabricated metal products, and transportation industries, the Pentagon owns most of those in the possession of the federal government. Rather than purchase the tools it needs to maintain and build on its materiel directly from producers, the military works through a large network of defense contractors. Demand for machine tools experienced clearly defined surges during the Korean conflict and the Vietnam years through 1968. However, the permanent war economy (during the Cold War) provided the industry with constant stimulus on demand to keep the military equipped. The Arms Control and Disarmament Agency report stated in 1969, that arms makers provide "a market for a relatively large share of the annual output of the machine tool industry, and although machine

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[91]SNEC=Subgroup on Nuclear Export Coordination, an interagency forum for reviewing nuclear dual-use commodities. The members represent the Departments of State, Defense, Energy, and Commerce, as well as the Arms Control and Disarmament Agency and the Nuclear Regulatory Commission. See the report, *Export Licensing Procedures for Dual-Use Items Need To Be Strengthened*, 1994.

tools of every type are used by the government or by private contractors producing military hardware, certain types are especially critical to military programs."[92]

The interdependence of the military and the machine tool industry can be demonstrated by comparing the military procurement spending rates in the postwar period with new orders for tools. During the period, 1950-1978, DiFilippo found an almost perfect match in the fluctuations of both trends. 1950-53 tool orders mirrored the increased Korean War defense spending, then both declined in the recession of late 1953-55. In a graphic comparison of the 23-year period 1956-1978, the correlation coefficient for the fluctuations in defense contract spending vs. domestic new orders of machine tools was r=0.8191.[93] DiFilippo uses this data to assert that the government applied military - Keynesian spending policies to help manage the business cycle.

DiFilippo concludes that the pattern of government spending on the U.S. machine tool industry reflected a high level of concern for the sustained competitiveness of the domestic producers. However, he demonstrates that the close relationship between the firms to state-supported contracts prevented them from innovating and investing in commercial research and development. The industry is thus regarded as important, but government support had a damaging effect during the Cold War. The Rand study reports that government spending on high-technology consortia have helped defray costs of research and development for dual-use technologies.

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[92]DiFilippo, 1986, p. 97.

[93]DiFilippo, 1986, Chart 7, p. 100.

IV. THE CASE OF IRAQ

> In Southwest Asia, the United States remains focused on deterring threats to regional stability, particularly from Iraq and Iran as long as those states pose a threat to U.S. interests, to other states in the region, and to their own citizens.
>
> *A National Security Strategy of Engagement and Enlargement*[94]

> It should also be recalled... that during the 1980s high-level U.S. policy was tilting toward Iraq in its war with Iran, and it may have been Administration political judgments -- rather than Commerce Department zeal for export promotion -- that led to questionable license approvals.
>
> *Export Controls and Nonproliferation Policy, OTA-ISS-596*[95]

A. INTRODUCTION

This chapter examines the case of Iraq, where Saddam Hussein used a global network of arms and technology dealers to build a vast array of weapons programs and facilities. The case is important because the international community won access to invaluable information about the global trade in threatening technologies through the inspections of Iraq mandated by the terms of the cease fire in the Persian Gulf War of 1991. Many lessons are being learned in Iraq about the inadequacies of the export control measures in the years preceding the crisis.

Iraq remains a "rogue" state with likely intent to rebuild its WMD programs. Other rogues, such as Iran, North Korea, and Libya, also present a WMD proliferation threat. However, inspections and safeguards in those countries are not as invasive as in Iraq, and much less is known about their WMD efforts.

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[94]*A National Security Strategy of Engagement and Enlargement* (Washington, DC: The White House, February, 1995) p. 30.

[95]OTA, 1994, p. 36.

In the case of Iraq, the international community must insist on maintaining long-term monitoring of all of Iraq's nuclear and missile facilities. It must be assumed that Saddam will continue to try to develop a WMD capability that would make him preeminent in the Middle East. The multilateral control regimes and ongoing UN and IAEA inspections must continue to press Iraq for information regarding those who supplied him with dual-use technology. Networks of activities found to be operating outside of the multilaterally accepted bounds must be curtailed, and transfers of destabilizing technologies must be blocked.

B. THE ARMING OF IRAQ

During the 1980's, the United States favored Saddam Hussein in the Iran-Iraq War. Iran represented the greater threat to the open sea lanes in and around the Persian Gulf. After Ayatollah Khomeini's successful Islamic revolution, U.S. interests and those of friendly Arab states now comprising the Gulf Cooperation Council were threatened. They depended on Saddam to counter the threat, which he did by attacking Iran. Saddam received arms and loans despite existing nonproliferation restrictions, partly to prevent him from leaning too far in the direction of the Soviet Union for help.

After Iraq's cease-fire with Iran, the United States continued to provide arms, technology and financial assistance to Saddam. The Bush administration believed it was in the U.S. national interest to improve relations with and strengthen Saddam, as a means of blocking both Iran and the Soviets from gaining control of Persian Gulf Oil. Therefore, the administration approved many exports based on foreign policy goals and underemphasized proliferation guidelines[96] . This political tilt ignored the fact that, as the GCC states cut off

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[96]William Hartung, *And Weapons For All*, (New York: HarperCollins, 1994), p. 220.

loans to Iraq after his war with Iran, Saddam's regime became insolvent. As discussed in more detail below, Saddam received billions of dollars in guaranteed loans from the U.S. to finance his weapons programs -- loans which the U.S. taxpayers are saddled with now.

For evidence of the administration's attempts to bypass controls, one can consider Commerce Department records. In mid-1993, the U.S. Commerce Department's Inspector General reported that computer printouts of export license requests were altered in 68 cases involving a total of $1.5 billion of high technology equipment to Iraq. The transfers occurred prior to the Gulf War. Despite the evidence of inappropriate transfers, no one was prosecuted for violating control rules.[97]

United States government assessments suggest that during FY 1988 and 1989, 23 licenses were approved for computer equipment to end users involved in uranium enrichment activities. Iraq is suspected to have used some of the computers to operate machine tools used to fabricate nuclear weapons components, centrifuges, and electromagnetic uranium enrichment equipment. "At the time these licenses were approved, only the Iraqi Atomic Energy Commission was identified as a sensitive end user; other Iraqi state establishments were not identified as potentially involved in nuclear weapons activities."[98]

However, the United States is not the only supplier Saddam used. He built a broad and complex global network for acquiring arms and technology. Much of the network was secret, both to get around the export control restrictions of Western countries, and to conceal the

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[97]N. Lewis, "U.S. Decides It Won't Prosecute Case of Altered Iraq Export Papers." *New York Times,* April 16, 1993, p. A10.

[98]See *Export Licensing Procedures for Dual-Use Items Need To Be Strengthened",* April 1994.

identities of suppliers from Israel. Even now, as UN and IAEA inspectors attempt to uncover the network, Iraq contends it must protect the traffickers from being killed by Israeli hit squads.[99] While this is possible, the more compelling motives for Saddam's reluctance to cooperate seem to be his desire to rebuild the network and resume his weapons development after the sanctions and embargo are lifted.

Just as the Bush Administration allegedly undermined nonproliferation control measures to further political goals, so were the leaders of other major powers inclined to support Saddam in his arms programs. As noted below, government involvement in Great Britain, France, Germany, Italy, and Japan significantly helped Saddam in gaining destabilizing technology.

C. IRAQ'S STATUS FOLLOWING DEFEAT IN 1991: INSPECTIONS AND REBUILDING

According to many observers, the sanctions imposed on Iraq following its defeat in 1991 were designed to keep Saddam from rearming, to secure full compliance with U.N. resolutions, to end Saddam Hussein's rule, and to punish Iraq.[100] Part of the implementation of the sanctions included extremely invasive inspections by the International Atomic Energy Agency (IAEA). The IAEA has carried out frequent and effective inspections, but the agency denies that it has an intelligence role. It cites three major purposes for its inspections and operations in Iraq under U.N. Resolution 687: to destroy WMDs, to ensure Iraqi disclosure

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[99]J. Arraf, "U.N. Nuclear Inspectors Plan 'Controversial Steps'." Reuter/Executive News Service, January 31, 1993.

[100]P. Clawson,*How Has Saddam Hussein Survived?: Economic Sanctions, 1990-1993.* (Washington, DC: National Defense University, 1993), pp. 6-7.

of its sources, and to provide for long-term monitoring of Iraqi facilities.[101] The United Nations set up a special committee, UNSCOM, to conduct inspections on its behalf.

The sanctions have taken a heavy toll on the Iraqi economy. It is widely believed that the sanctions have prevented Iraq from earning the hard currency required to buy dangerous technologies. Saddam has had the option of selling approximately $1 billion of oil to purchase badly needed food, medicine, and other humanitarian goods for his people. He has refused to take advantage of this provision in the terms of the sanctions because he does not want to give up any control over spending the revenues.[102] It is believed that his priority for state spending is in his military programs.

His defiance in the face of the sanctions and inspections took a dangerous turn in January 1993, when inspectors' flights into Iraqi airspace were essentially blocked. The U.S. responded by bombing Saddam's military facility at Zaafarniyah (known as Al Rabee). Inspection teams had concluded that no improper activity was occurring at Al Rabee and that it was of negligible strategic significance, but American intelligence reports suggested otherwise. They asserted the facility was Iraq's most advanced nuclear weapons production plant, furnished with parts for electromagnetic separators or calutrons, used for enriching nuclear material. U.S. officials claimed the bombing destroyed computerized, numerically controlled (CNC) milling, grinding and turning machines which could have enabled Iraq to

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[101]J. Wolfsthal, "Iraq Gives IAEA Nuclear Supplier Data After Long Delay." *Arms Control Today*, November, 1993, p. 21, and "Report on the 17th IAEA On-Site Inspection In Iraq Under Security Council Resolution 687 (1991)" UNSC Doc S/25411, March 13, 1993).

[102]Clawson, 1993, pp. 43.

revive its WMD program.[103]

American sources reported that the bombing damaged or destroyed most of the key buildings in the complex, including computer controlled lathes and multi-axis milling machines from Western Europe.[104] It was believed the machinery would be impossible to replace in light of the sanctions.

IAEA officials worried about the repercussions of the attack further hindering their activities. The IAEA required considerable cooperation from Iraq in order to establish long-term monitoring.[105] IAEA reports are typically more optimistic about progress, perhaps as a diplomatic means of coaxing cooperation.

Immediately after the attack, Saddam agreed to allow the inspectors to continue with their work. However, within two months, the facility was rebuilt, and equipment which had been removed prior to the attack was re-installed at Al Rabee.[106] The events indicated the resilience of Saddam's military development program in spite of sanctions and inspections. It also pointed out Saddam's resourcefulness in safeguarding sensitive equipment. It is believed that much of the technical equipment Saddam had acquired prior to the Gulf War had

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[103]Mark Hibbs, "IAEA In 'Difficult Position' After U.S. Attack On Iraq Site," *Nucleonics Week*, January 21, 1993, pp.11-12.

[104]M. Healy, "Weapons Plants Inviting Targets For New Attacks." *Los Angeles Times,* January 18, 1993. pp. A1, A25.

[105]Hibbs, 1993. p. 12.

[106]L. Barkho, "Iraq May Still Have Uranium Enrichers -- Expert." Reuter/Executive News Service, April 30, 1993.

been hidden and will be available to Iraq in its plans to rearm.[107]

Saddam assigned the task of preserving the facilities, presumably by converting them to civilian use, to General Hussein Kamel Hassan, an "advisor on industry and oil."[108] Hassan's efforts had convinced the IAEA teams that none of the machinery reinstalled at Al Rabee was being used for banned activities. Another military officer, Lt. Gen Amir Rashid, was put in charge of protecting Iraq's most advanced production equipment from allied bombers and UN inspectors, including CNC machine tools manufacturing centers and liquid nitrogen plants.[109] By September 1993, The IAEA concluded that no highly enriched uranium was left in Iraq, and the Iraqi capacity to produce it was eliminated -- though some acknowledgment was made that cheating could occur.[110]

Given American concerns over the possibility of Iraqi "cheating", other sites were identified as potential targets for future strikes against a defiant Saddam. Complexes at Iskandaria, Hamath, Hatteen, Fallouja, and Nasr State Establishment contained foundries, magnet-test facilities, calutron parts, and components of the super-gun.[111]

The IAEA has sometimes suggested the sanctions be eased in recognition of Iraq's compliance with resolutions, and as a reward in advance reward for submitting to long-term

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[107]L. Barkho, "Watch On Iraq Urged: Long-Term Plan On Nukes Sought." *Washington Times*, March 8, 1993.

[108]Barkho, April 30, 1993.

[109]"Does Iraq Have The Bomb?" *MedNews,* January 25, 1993, pp. 1-3.

[110]S. Pagani, "IAEA Plans To Step Up World-Wide Nuclear Checks." Reuter/Executive News Service, September 27, 1993.

[111]Healy, January 18, 1993.

routine nuclear checks. Other experts fear that much of the estimated $12-15 billion in annual oil revenues that Saddam would receive would go to weapons modernization programs.[112] Saddam was quick to reestablish his conventional military-industrial base, in spite of severe hardship his policies caused among the Iraqi people. The UNSCOM chairman, Rolf Ekeus, said international restrictions would remain until there is evidence of Iraqi "good will" with respect to militarism, despite Iraq's acceptance of long-term monitoring as stipulated in UN Resolution 715.[113]

D. REVELATIONS AND ALLEGATIONS

Among the many revelations to emerge from the investigations into Saddam's sourcing network is the key role of American financiers in assisting Iraq's arms buildup. In particular, the role of Christopher Drogoul, manager of the Atlanta branch of Italy's Banca Nazionale del Lavoro (BNL), has proven to be a critical link. Drogoul was Saddam's primary source of American financing, obtaining over $4 billion in guaranteed loans and credits following the Iran-Iraq war.[114] Drogoul alleges that the transactions were approved with the knowledge of top-level officials in the Bush administration, as well as in the British and Italian

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[112]A. Borowiec, "Saddam Still Playing For Power." *Washington Times*. December 8, 1993, p. A13.

[113]E. Leopold, "Iraq- U.N. Talks Adjourn With Arms Pact Still In Limbo." Reuter Executive News Service, September 13, 1993, and Borowiec, December 8, 1993, and P. Lewis, "Bowing to U.N., Iraq Will Permit Arms Monitors." *New York Times*, November 27, 1993, pp. A1, A5.

[114]Hartung, 1994. p. 227.

governments.[115] Some acknowledge that such conspicuous sums could not have been approved, given Iraq's insolvency after the war, without the knowledge of highly placed federal regulators. Drogoul testified to Congress that he was a tool of the U.S. government, providing a conduit of resources to Iraq with the full knowledge of the CIA and the Departments of Agriculture and State.[116] The funds were often approved as EXIM bank loans or guaranteed loans under the U.S. Department of Agriculture's Commodity Credit Corporation (CCC) program, but were used for the purchase of sensitive computers and technology.[117]

Investigations into the BNL scandal have been spearheaded by Congressman Henry B. Gonzales of Texas, House Banking Committee Chairman, who has uncovered links to several illegitimate or front companies and projects. Among them are Matrix Churchill of the U.K., which is emerging as a key technology supplier, and XYZ Corporation of Alabama. XYZ provided precision machine tool bits and training, allegedly for truck engines. The tungsten carbide bits have been identified as a dual-use item employed in missile warhead production. XYZ's technicians found themselves working in one of Iraq's major weapons facilities at the time of the 1990-91 crisis, and had to flee the country.[118]

The XYZ case is one example of Iraq's secret international projects, another being the

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[115]S. Tisdall, "Inquiry To Examine Arms Export Scandal." *The Guardian*, 1993. September 13, 1993.

[116]A. Friedman, "CIA Knew BNL Loans To Iraq, Says Former Banker." *Financial Times*, November 10, 1993.

[117]Hartung, 1994, p. 224.

[118]Hartung, 1994, p. 231.

Condor II missile program. Originally conceived as a joint Iraqi-Argentine-Egyptian venture to build an improved version of Argentina's Condor ballistic missile, Iraq's partners pulled out by 1988. Working with Drogoul for funding and billing it as the "Badush Dam" project, Saddam attempted to develop the missile on his own. Though it was not completed before the war, it is another case where high-level western approval was necessary for key exports, and where political expedience seemed to play into Saddam's hands.[119]

Agencies within the Congress which review license and funding requests claim they were misled by administration reports into believing the resources were for legitimate civilian development projects. They claim the possible military uses of the technologies were excluded from the reports, and they did not have adequate information on which to review the dual-use cases properly.[120] They suggest the restriction mechanisms built into the U.S. export controls were bypassed for reasons of foreign policy.

Other revelations include the roles of a long list of states in contributing to the procurement network. Among them are Russia, Algeria, Jordan, Germany, Japan, France, and the United Kingdom.

Russia is believed to have provided vast amounts of nuclear material and scientific knowledge. With its struggling economy, the arms trade is seen as a major source of currency and an outlet for its glut of highly-trained scientists.[121] Russia's involvement in the multilateral

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[119]Hartung, 1994. p. 230.

[120]W. Carley, "Who Let Whom Arm Iraq?" *Wall Street Journal*, January 6, 1994, p. A10.

[121]K. Belyaninov, "Nuclear Expertise, Materials Export Feared." *Proliferation Issues*, March 5, 1993, p. 21.

export control regimes has been peripheral as it has transitioned to a market economy. Current revisions of multilateral efforts stress the close involvement of Russia in nonproliferation and call for stronger national rules in Yeltsin's government to control exports.

Algeria is believed to be supporting Saddam's nuclear weapons program by hiding critical equipment, materials, and personnel from the IAEA. Algeria has itself applied for more active status in the nuclear community, and is feared as a possible future proliferator. This status is believed to be the result of collusion with Saddam.[122]

Jordan, as Saddam's friendliest neighbor, is also believed to have provided a large number of front companies to the procurement network. Once equipment arrives in Jordan, it passes easily across the border into Iraq.

Germany is now seen as the worst violator of controls designed to restrict weapons and military-specific materials destined for WMD programs to Iraq, as well as providing the most advanced centrifuge technology. The numbers of centrifuge parts sold was insufficient for Iraq's needs, but design information provided by Bruno Stemmler through H&H Metalform, and by Karlheinz and Brigitte Schaab of Ro-Sch GmbH, is believed to be highly sensitive and remains in Iraqi hands and heads.[123] The cases have resulted in legislation

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[122]A. Wheatley, "Iraq Could Make Nuclear Weapons if U.N. Lifts Sanctions." Reuter, October 13, 1993.

[123]D. Albright and Mark Hibbs, "Supplier-Spotting." *The Bulletin of the Atomic Scientists*, January-February, 1993, pp. 8-9.

strengthening the German Foreign Trade Act.[124] German firms also provided high grade maraging steel, hot isostatic presses and precision pump equipment.[125]

Japan has also strengthened its national export control legislation, after it was revealed that several firms provided Saddam with precision tools. Given the close relationship between industry and government ministries in Japan, the roles of state officials in the transfers have been questioned.[126]

France has historically been an eager supplier of arms to Iraq. Its Skiaky firm built at least five electron beam welders at the Al Rabiya site and elsewhere, machines which are considered key to the production of gas ultra-centrifuges for the enrichment of uranium.[127] While it also has reviewed its role in arming Saddam and the degree of its compliance with controls under nonproliferation agreements, France has been among the first to reopen offices in Iraq for trade contracts in anticipation of the lifting of the embargo.

Great Britain has endured a very embarrassing scandal involving the Matrix Churchill multinational corporation, essentially owned by Iraq. Its CEO, acting as an informant for British intelligence MI6, implicated senior Foreign Office officials, including its Minister of State, William Waldegrave. Even Prime Minister Thatcher allegedly undermined her country's

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[124]Mark Hibbs, "Bundestag to Seek Iraq Briefing In Light Of New Baghdad-IAEA Data." *Nuclear Fuel.* December 6, 1993, p. 9.

[125]Mark Hibbs, "German Couple Convicted For Centrifuge Exports to Iraq." *Nucleonics Week*, November 11, 1993, pp. 8-9.

[126]"IAEA Says Japanese Tools Used In Nuclear Project." *Proliferation Issues*, February 5, 1993. p. 23.

[127]"G7 To Tighten Controls." *MedNews*, January 11, 1993. pp. 4-5.

export control laws to arm Saddam with threatening technologies. Some of the accused argue that the military use of the exports was hidden from them. At the same time, they note that the guidelines and policies were reinterpreted in Iraq's case, requiring the government to prove intended military end use if it wanted to block export of the dual-use items. The Ministers asserted it was commonly assumed Saddam would focus on his civilian industries after the long and costly war with Iran.[128] Proof of military use was considered a waste of time. Later, Thatcher's aides claimed she approved sales of millions of pounds sterling worth of machine tools to prevent the compromise of intelligence activities if the deal failed.[129]

According to the IAEA, Matrix Churchill supplied Iraq with 13 of the 47 most vital pieces of equipment used in the Iraqi nuclear weapons program.[130] Many key figures sought for information in the case, including both British and Iraqi officials and scientists, were killed before they could provide evidence.[131]

Among the Western scientists who sold his knowledge of advanced weapons systems to Saddam was Dr. Gerald Bull. He helped Saddam's defense and industrial chiefs establish production facilities in the Iraqi desert and in the zones south of Baghdad. His association with Iraq's WMD programs eventually cost him his life, possibly at the hands of Mossad

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[128]D. Connett, "Foreign Office Lacked Evidence of Arms Buildup." Independent, September 15, 1993.

[129]K. Helliker, "Britain's Major Denies Knowing of Iraq Arms Deals." *Wall Street Journal,* January 18, 1993, p. A12, and "Ex-Aide Disputes Thatcher On Iraq," *International Herald Tribune*, December 16, 1993.

[130]Connett, September 15, 1993.

[131]"Dead Men Tell No Tales," *Foreign Report*, January 7, 1993.

agents, but not before he designed a "supergun" cannon for Saddam, intended to threaten the State of Israel. Bull's case is of interest because he assisted in the procurement of dual-use machine tools, in violation of export control restrictions.

Gerald Bull believed that the Iraqis were at least ten years from nuclear weapons while he was working for them. He thought they would equip any missile he worked on with a conventional high explosive warhead.

Bull needed cones for his missiles as well as a supply of carbon fiber material. To get what he required, he supported the establishment of a network involving the Baghdad-based Al-Arabi Trading company, under the control of Hussein Kamil, minister of industry and military industrialization. It was Kamil who was charged with perfecting nuclear weapons and their ballistic missile delivery systems for Saddam. Al-Arabi Trading bought Technology Development Group (TDG), a British holding company, in 1987. Immediately, TDG bought Matrix-Churchill, a manufacturer of computer-controlled lathes.[132]

From 1987-88, Matrix supplied Iraq with three orders worth 19 million pounds sterling, then contracted to establish a high technology die-forging plant in Iraq for 26 million pounds. The projects were financed through BNL-Atlanta.[133] Some lathes turned up at the military-industrial complexes at Al-Hillah and Saad-16 south of Baghdad, for making weapons designed by Bull. Dr. Bull also helped Iraq set up front companies in Europe to buy restricted parts necessary to build its own gas centrifuges, devices that transform non-

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[132]See W. Lowther, *Arms and the Man: Dr. Gerald Bull, Iraq and the Supergun*. New York: Ivy Books, 1991, p. 210.

[133]Lowther, 1991, p. 211.

enriched uranium ore into Uranium 235 -- the basis of nuclear bombs.[134]

E. THE CONTINUING THREAT

Inspectors have compared their inventories of equipment found in Iraq to export records of suppliers and have identified many discrepancies. They suggest the equipment unaccounted for is hidden, and either in use in secret underground facilities or in storage.[135] Experts from IAEA and UNSCOM agree that Saddam can rebuild quickly and must be closely watched. His intent to develop WMDs is a clear and present danger to the stability of the region. The international community has the advantage in the case of Iraq of continued access and monitoring. That advantage is not there with the other rogue states: Libya, Iran, and North Korea. It has been made quite clear that the international arms and technology network is extensive, efficient, and largely invisible. As the United States and other nations attempt to negotiate new cooperative arrangements in the new world order, they consider ways to win friends and build leverage through increased trade and technology transfers. Optimistic actors in the international scene point to the advantages of broadening democracy and industrial development worldwide, while thawing relations with former adversaries. There is always pressure to respond to civil overtures on the part of rehabilitated regimes with assistance. For example, the IAEA foresees a legitimate Iraqi nuclear power program which will require the installation and use of sensitive equipment.[136] This climate can, as seen in the case of Iraq, lead to proliferation of threatening technology. The safeguards embodied in

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[134]Lowther, 1991, p. 209.

[135]Wheatley, October 13, 1993.

[136]*MedNews*, January 11, 1993.

standard IAEA inspections may not be adequate to prevent their development of weapons. Long-term, rigorously intrusive monitoring is called for, but will always be a source of bitter resentment by the Iraqi people and leadership.

F. PRESCRIPTIONS

There are many lessons for the improvement of the export control system which have been learned from the Iraqi case. The global character of the international arms trade requires a high level of cooperation among supplier countries to stem proliferation. Multilateral regimes are the best hope for slowing the spread of threatening materials, but not all countries are able to track sales and end users. The concerted sharing of information via computer networks can alert the international community to suspicious programs. To achieve a comfortable balance between security concerns and exporters' freedom to compete, sales should be considered on a case-by-case basis. Greatest attention goes to attempts by rogue states to acquire sensitive items. Dual-use equipment in particular should be regulated with flexible but coordinated policies.

That coordination must occur within the responsible agencies of each country as well. For example, in the United States, the decision to approve licenses must be routed efficiently through the bureaucracies of the Departments of State, Commerce, Energy, and Defense (such as the Defense Technology Security Agency), as well as through the appropriate Congressional and Banking regulators. This includes close contacts with industry and private financial institutions to ensure information is up to date. Since each agency is traditionally inclined to favor or reject actions based on its own parochial interests, a more objective system of assessment must be found to weigh the potential costs and benefits of exports. This

equation must determine which technologies are sensitive and why, which are destabilizing to the customer's regional security, and how to ensure the legitimacy of the final use.

The international regime, led by the U.S., provides a guide for the improvement of national export controls in other countries.[137] Therefore, credible unilateral measures should be regarded as important precursor arrangements to be emulated, copied, and eventually incorporated internationally.

In addition to the transfer of technology, the training of foreign students, officers, and scientists in western schools must be closely regulated. There have been many cases of technicians studying in the United States and applying their skills in the weapons facilities of Iraq. It can be assumed that exchange programs in both the West and in the former Soviet Union involving Iran, Iraq, Egypt, Libya, Yemen, China, Russia, Argentina, Pakistan, India, and South Africa have provided a pool of talent for rogue regimes.[138]

In Iraq, the international community must continue to pressure Saddam to comply with U.N. resolutions, including submitting to long-term monitoring and divulging all sources. The stability of the region may require a strong Iraq to counter Iran, but the regime is much too unpredictable to be trusted. The IAEA may work for a legitimate civilian nuclear power program in Iraq, but not until means are in place to prevent nuclear weapons development. Much of the responsibility for preventing WMD programs in Iraq rests with responsible exporters and clear export control measures, practiced and enforced multilaterally.

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[137]M. Tachinardi, "Congress Urged To Approve Dual-Purpose Military Goods Bill." *Gazeta Mercantil*, (Sao Paulo), Feb 11, 1994, p. 9.

[138]Belyaninov, March 5, 1993.

V. CONCLUSIONS

> American leadership in the world has never been more important, for there is a simple truth about this new world: the same idea that was under attack three times in this Century -- first by imperialism and then by fascism and communism -- remains under attack today, but on many fronts at once... Our struggle today, in a world more high-tech, more fast moving, more chaotically diverse than ever, is the age-old fight between hope and fear.
>
> *A National Security Strategy of Engagement and Enlargement*[139]

> Trade is a social act. Whoever undertakes to sell any description of goods to the public, does what affects the interests of other persons, and of society in general; and thus his conduct, in principle, comes within the jurisdiction of society.
>
> John Stuart Mill, *On Liberty*, 1859.[140]

A. IMPLICATIONS

The threat to U.S. interests of proliferation of weapons of mass destruction (WMD) has increased during the post-Cold War era due to globalization of defense technology industries. Diffusion of sensitive dual-use technologies, including advanced precision machine tools, contributes to proliferation. Reform of unilateral export controls and the establishment of a multilateral control regime to succeed the Coordinating Committee for Multilateral Export Controls (COCOM) are both necessary, but must complement each other to be effective.

It is not feasible for the United States to withdraw from multilateral arrangements and apply controls unilaterally. Foreign availability of advanced technologies, together with a lack of consensus regarding the modalities of multilateral controls, render unilateral controls

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[139]*A National Security Strategy of Engagement and Enlargement*, (Washington, DC: The White House, February 1995), pp. 1-2.

[140]Quoted from *Proliferation Watch*, Senate Committee on Governmental Affairs, September-October 1993, Vol. 4, No. 5, p. 1.

damaging to U.S. exporters without slowing the spread of WMD.

Export controls involve a tradeoff between nonproliferation goals and economic competitiveness of U.S. industries. Both WMD spread and the health of commercial technology sectors concern national security, as the United States strives to maintain a qualitative edge on the battlefield. This thesis frames the arguments in the nonproliferation-competitiveness debate. It suggests there is common ground between the exporters and proponents of export controls; the United States must assume the hegemonic role of principled leader in the multilateral control regime. It must push for consensus on the modalities of controls (commodities and technologies subject to controls as well as an outline of governing rules). This requires a more rigorous and nuanced means of assessing the costs and benefits of specific controls. Also, the United States must push for a clear statement of criteria and responsibilities of member states to avoid free rider behavior. The successor to COCOM must involve the formerly targeted communist states and use positive incentives to compel more states to eschew proliferation activity. Furthermore, the United States must use its intelligence and information technologies to lead the effort to monitor proliferation activity and enforce rules. As the multilateral regime results in wider access to technology and developmental capital for members, and damaging isolation for targets states, proliferation activity may decrease, and the commercial market for civilian end-users will develop and expand.

This thesis examines the case of Iraq, where highly intrusive inspections and monitoring following the Gulf War have yielded valuable information about Saddam Hussein's global procurement network for his WMD programs. The case provides evidence for the

argument that export controls can be undermined by short-sighted political decisions, carrying the danger of arming a rogue state. Inspections have revealed the key role of computer numerically-controlled (CNC) machine tools in the development of WMD programs. They are necessary for the enrichment of fissile materials and for the building of precision components of missiles, aircraft, and other devices. Saddam's WMD programs focused on the procurement of machine tools to give him an indigenous development and production capability. Much of his inventory of tools may have survived the war and the inspection process, reducing the time and resources necessary to revive his WMD efforts once sanctions are lifted.

Prescriptions call for strong controls on a limited list of sensitive technologies, and firm policies against rogue behavior. A more sophisticated monitoring and information-sharing network is needed to track proliferation patterns. The United States must ensure positive incentives are made part of the rules, as in the Nuclear Nonproliferation Treaty, to draw states into a verifiable, cooperative posture with regard to nonproliferation. Firm but fair leadership of multilateral efforts must reflect the position of the United States as the world's sole superpower.

B. TOPICS FOR FUTURE RESEARCH

This thesis argues for a strong hegemonic role for the United States in The New Forum. Unfortunately, this successor regime to COCOM has experienced many delays in becoming established, largely because of a lack of international consensus for rules and modalities. The United States has been unable to lead effectively the negotiations to set up The New Forum, because our own debates about the costs and benefits of export controls for

dual-use technologies in the post Cold-War era have lacked objective analysis.

Serious work on the quantification of the costs to exporters of controls is required, along with the operationalization of the benefits of nonproliferation. This will serve to eliminate much of the bias in perspective and values among exporters and proponents of strong controls for nonproliferation goals, and provide an objective basis for comparing both sides of the cost-benefit-risk equation.

Since export controls are only effective in slowing, and not in stopping, the spread of sensitive commodities, an effective network of information-sharing and monitoring must be established. Research on the feasibility of open-source, i.e., commercial, intelligence collection must be conducted to determine corporate and legal requirements. The data-sharing network being developed for the Nuclear Suppliers Group will provide important insights and lessons to the dual-use Forum for monitoring purposes.

This study focused on the case of Iraq in order to emphasize the proven potential for proliferation by an "emerging rogue" regime. The evidence suggests other states with aspirations for regional hegemony, power, and prestige, or who see themselves sufficiently threatened, will pursue WMD programs and by-pass existing trade controls. Investigative research into proliferant activity must continue, both from a demand side and a supply side. It is especially critical in this new era, given the heightened incentives to transfer technology for badly-needed foreign currency by the struggling former Soviet states.

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